dicular to the face of incidence, determined by the incident and interior portions of a ray entering the prism at O and leaving it at O'; let GH be the intersection of these two planes: and let ON be normal to the face of incidence at O. Draw OM normal to the principal plane, and connect M with L and K, the points on the intersection GH determined by the interior ray and the incident ray extended, respectively.

Since GH is the intersection of two planes both of which are normal to the incident face, it also is normal to that face and, therefore, parallel to ON. Hence the

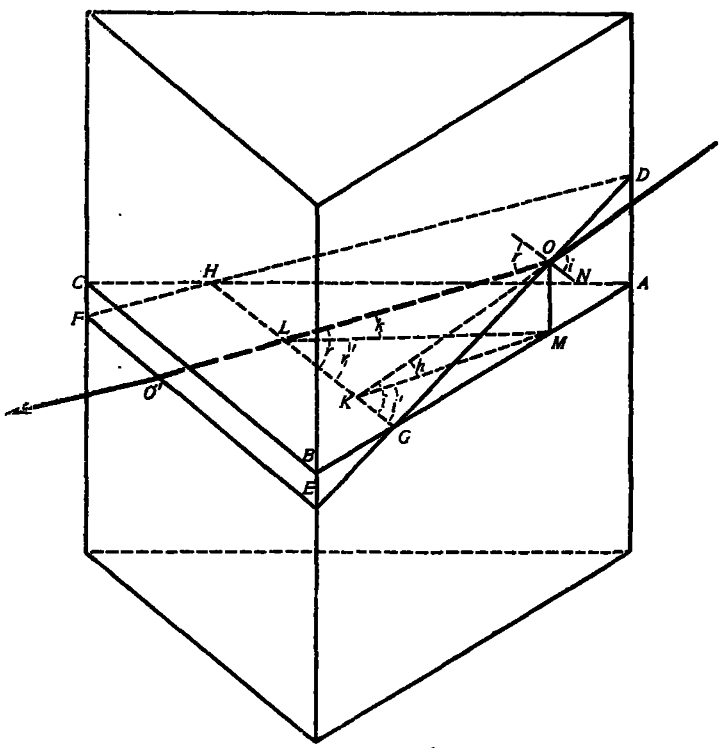

FIG. 1.—Path of a ray inclined to the principal plane.

angle OKG is equal to the angle of incidence, i, and the angle OLG equal to the angle of refraction, r.

Clearly, then, since

$$\sin i = \mu \sin r,$$

if, in length, $KO = 1$, it follows that

$$LO = \mu,$$

and $\sin h = \mu \sin k$, in which h and k are the angles between the principal plane and the incident and interior rays respectively.

The angles between the principal plane and the incident and interior rays, respectively, are connected by the law of sines.

Similarly,

$$\sin h' = \mu \sin k',$$

in which h' and k' are the angles between the principal plane and the exit and interior rays, respectively. But, obviously,

$$k' = k, \text{ hence } h' = h.$$

The incident and the exit rays are equally inclined to the principal plane.

Finally, if i' and r' are the projections of i and r, respectively, onto the principal plane, then

$$\mu \cos k \sin r' = \cos h \sin i',$$

or

$$\frac{\sin i'}{\sin r'} = \mu' = \mu \frac{\cos k}{\cos h}.$$

A ray inclined to the principal plane of a prism is so bent that its projection on this plane is the course a ray in this plane would take if the refractive index of the medium were increased by the ratio of the cosines of the angles between this plane and the internal and the incident (or exit) rays, respectively.

RARE HALO OF ABNORMAL RADIUS.

By A. F. PIPPO, Observer.

[Madison, Wis., May 12, 1922.]

On April 27, 1922, there was observed at Madison, Wis. (lat. 43° 05′ N, long. 89° 23′ W.), a very distinct form of solar halo of abnormal radius occurring simultaneously with a very brilliant halo of 22°. Halos of abnormal radius of less than 10° have been recorded probably less than a half dozen times in the United States, references to those on record in the MONTHLY WEATHER REVIEW being **43**:213, **43**:592, **47**:120, **47**:340.

The rare occurrence of such halos warrants special record being made thereof. Photographs of the halo in a black convex mirror were made. These failed due to lack of filters. Approximate theodolite readings establish the radius at about 8° 12′.

The appearance of the halo was first noted by the writer at 2:15 p. m., 90th meridian time. The sky was nearly overcast with a thin, whitish cirro-stratus veil (west) except where patches of cirro-cumuli appeared apparently at a lower level (WNW.). The smaller halo appeared as a distinct white ring of not more than 1° in width, the accompanying 22° halo being brighter than usual.

There was little change in the conditions of the phenomenon until 2:50 p. m., when for a short time it attained its greatest brilliancy. The 22° halo showed greater coloring at its upper and lower parts, appearing slightly elliptical. However, no measurements to indicate the distortion were made. The 8° halo continued as a whitish ring except that in the upper righthand quadrant could be seen the reddish blue tinge. Sun's altitude 47° 18′ at approximately 2:50 p. m. The phenomenon was easily visible until 3:10 p. m., when it disappeared behind a dark patch of cirro-cumulus. The 22° halo of average brightness was recorded at 7:30 a. m. and again at 6:15 p. m.